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IMPORTED CARABID BEETLE MAY BE A POTENTIAL PEST

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Early this year a complaint was received from Mr. George A. Cameron of Inverness, Nova Scotia, that black beetles were numerous in the basement of his home. They were crawling into stored milk and meat, as well as into flour bins; in fact, they showed a great liking for places difficult of access. On occasions they appeared in other rooms of the house, even dropping down into the shades of lighting fixtures. Similar trouble had been experienced the previous year. No actual damage was reported aside from waste when the presence of beetles necessitated the discarding of food stuffs.

Specimens forwarded proved to be carabids which keyed in available keys to the *pennsylvanicus* group of the genus *Harpalus*, but which were strikingly different in having the elytral intervals finely punctate and covered with a vestiture of short, fine, golden colored hairs. Mr. W. J. Brown, Division of Entomology, Ottawa, has kindly determined these specimens as *Pseudophonus rufipes* DeG., an imported European species. Brown (16) reported the first Canadian record of this species from specimens taken by himself at Tabusintac, N. B., during the summer of 1939. Since then the Canadian National Collection has acquired specimens, dated 1937, from Charlottetown and Summerside, P. E. I., and 1938 from King's County, N. S. Specimens were taken at Brackley Beach and Dalvay House, P. E. I., in 1940, and the species is present, Mr. Brown informs me, in other collections made this summer on Prince Edward Island. A somewhat general distribution, especially in sandy soils, seems to be indicated.

A check of the abstracted European literature reveals this species, recorded under several different names (*Pseudophonus rufipes* DeG., *P. pubescens* Müll., *Harpalus rufipes* DeG., *H. ruficornis* F., *H. pubescens* Müll., *Ophonus rufipes* DeG. and *O. pubescens* Müll.), and a related species, *Pseudophonus griseus* Panz., as widespread in Europe. In the literature cited are records from Germany (2, 8, 14, 15), Holland (3, 6), Estonia (7), Bulgaria (9), England (4, 5, 12, 11), Finland (10), and Denmark (13). In practically every instance *P. rufipes* DeG. is recorded as a pest of strawberries, eating out the seeds and destroying the fruit in so doing. The damage reported varies from 50 to 80 per cent of the crop. The control advised is, for the most part, trapping in baited or unbaited pots, with smooth sides, sunk level with the ground and in some cases partly filled with water on top of which a little kerosene is placed. This method is suggested by the frequency with which carabids are trapped in open trenches. Only one record (12) refers to an infestation of a house. This took place at an estate in Warwickshire, in June, 1938. The house involved was situated on land previously planted to potatoes and said to have been heavily infested with wireworms. Pyrethrum powder was used, and 300 beetles were swept up in one night. Walker and Kearns (5) record pyrethrum sprays as ineffective.

Mr. Cameron, who forwarded the beetles to Macdonald College from Inverness, N. S., found that they fed voraciously on puffed wheat kernels when in captivity. Given sand to crawl on at the college, they immediately burrowed into it but came up at night to feed on the proffered puffed wheat. They proved

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resistant to food dipped in sodium arsenite-sugar "ant bait", though they ate it readily. (Zolk (7) found arsenical baits ineffective but secured good results with phosphorus and sugar.) After being required to crawl through a ridge of sodium fluoride, the beetles died within a few hours.

Webster (1) records an American species, *Harpalus caliginosus,* as occasionally very serious in strawberry fields in Ohio. He also refers to records by Ormerod and Bos in the earlier European literature of the related *Harpalus ruficornis* feeding on strawberries in Holland, England, and elsewhere in Europe. The American species, *Harpalus pennsylvanicus,* is said by Webster to feed occasionally on the seeds of the common ragweed, *Ambrosia artemisiaefolia,* and on grains.

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IRON FRAUDATOR TRAVER VS. *IRON PLEURALIS* BANKS (EPHEMERIDA) *

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McDunnough (1938, pp. 32-33) has raised the question of the validity of *Iron fraudator* Trav. A specimen sent to him by Dr. Traver as the true *pleuralis* was treated with caustic potash and mounted in balsam. This "proved ..... identical with a genitalic slide made from a male paratype of *fraudator,* Trav. ..... Other slides of similarly distorted material ..... gave similar results."

Spieth (1938, pp. 7-11) has also questioned the validity of *I. fraudator*, giving additional evidence that this species is, in reality, a stage of *I. pleuralis* in which the penes have become expanded.

In the series of *Iron* in the author's possession, there are two interesting specimens in which, in the dried condition, one side of the penes is apparently that of *I. fraudator* Trav., while the other side is that of *I. pleuralis* Banks. One of these specimens was taken at the Dolly Copp Camp in the White Mountains, New Hampshire, on June 6, 1940, by Mr. John F. Hanson. The other was taken at Sunderland, Massachusetts, April 23, 1938, by the writer. Figures 1A-1C show the condition of the penes from the White Mountain specimen before and after soaking overnight in potash and after mounting in balsam. From a study of these figures it is evident that the normal, or relaxed, condition of the titillators is retracted, and further that, as McDunnough suggests, the shape and position of the titillators depends on the amount of tilting of the penes when mounted in balsam.

Fig. 1. Male genitalia of *Iron*.
A. Ventral view; dried specimen.
B. Lateral view; after soaking overnight in potash.
C. Dorsal view; mounted in balsam.

The following observation will also substantiate the view that the position of the titillators (i. e., whether drawn in as in *I. fraudator* or thrust out as in *I. pleuralis*) is not a valid character for specific identification. On May 6, 1941, the writer took a single male specimen of an *Iron* at Amherst, Massachusetts. This specimen was placed in a small cyanide bottle, and its actions watched with the aid of a 14x hand lens. One of the titillators was seen to be thrust in and out rather rapidly and convulsively. The other titillator was out of focus and its actions could not be observed. After the specimen had been brought back to the building it was identified as a typical *I. fraudator* Trav. From this observation it is evident that a specimen might die in the cyanide bottle in a condition in which the titillators are extended, whereas another similar specimen might, at the moment of complete paralysis, have its titillators drawn in. These observations, together with those of McDunnough and Spieth, present sufficient evidence for the author to advocate reduction of *Iron fraudator* Traver to synonymy with *Iron pleuralis* Banks.

The author wishes to express his thanks to Mr. J. F. Hanson for part of the material on which this paper is based; and to Dr. J. R. Traver for her encouragement, her help in reading the manuscript, and her loan of reprint material.

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TWO NEW SPECIES OF TICKS FROM BRITISH COLUMBIA (IXODIDAE) *

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Two new species of *Ixodes* are described herewith. Both have been recognized for the past ten years as differing in certain respects from known species. Published descriptions of them, however, have been withheld pending a fuller knowledge of their distribution and further studies on the stability of certain differences between them and allied species. The acquisition of further study material having shown that differences are constant, the writer now feels justified in erecting two new species, thus differentiating these ticks from allied species with which they have been confused.

Ixodes hearlei n. sp.

Female. (Plate XV, Fig. 1–9). Dimensions of unengorged holotype 2.52 mm. (to tip of scapula) by 1.57 mm.

Dorsal aspect

Capitulum. Length 550 microns (tip of hypostome to dorsal ridge); width (at cornua) 410 microns. Surface of basis capituli moderately rugose; dorsal ridge broadened distally into distinct cornua. Porose areas circular and about 80 microns in diameter; interval 120 microns, and distance from outer margin of area to lateral ridge about 45 microns; centre of basis capituli a light brown; anterior shoulders slightly rounded and forming an angle of about 55 degrees with the hypostome. At insertion of chelicerae and hypostome, a slight excavation.

Palpi. Extending about 30 microns beyond tip of hypostome. Total length of articles 2 and 3, 380 microns; article 2, 240 microns. Lateral profile of articles 2 and 3 straight; median profile fairly evenly convex. Surface and contours moderately rugose.

Scutum. 1.05 mm. by 1.0 mm.; broadest in front of middle; interscapular depression concave and 100 microns deep (from level of tips of scapulae). Surface rugose, with numerous evenly placed punctations. Hairs absent. Scapulae moderately sharp but project very little beyond the body contour and are heavily chitinized. Cervical grooves shallow and divergent. Marginal grooves prominent; postscutal area covered with numerous hairs.

Legs. Brown in colour, tarsi humped. Tarsus I, 400 microns; metatarsus 300 microns.

Ventral aspect

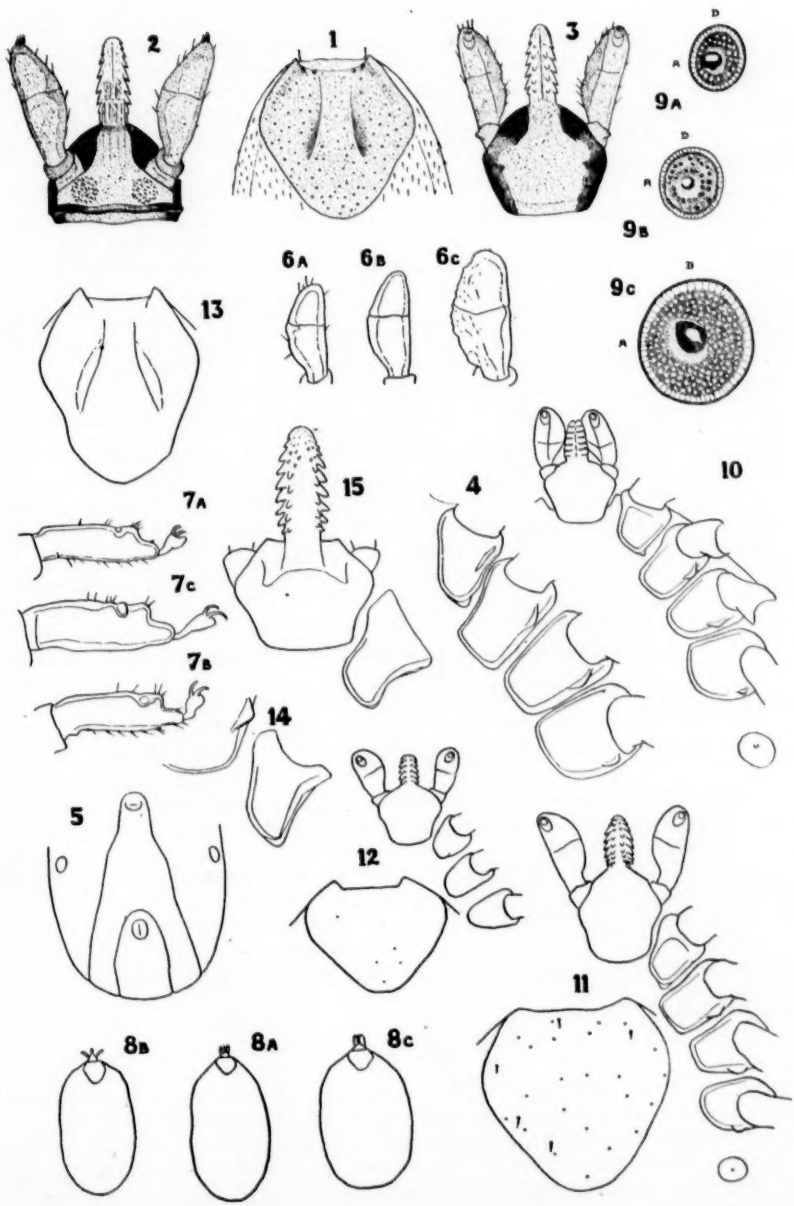
Capitulum. Shiny and slightly rugose. Anterior shoulders heavily chitinized and sloping back from hypostome. Auriculae absent. Hypostome blunt, 270 microns long (from tip to lateral junctions of basis capituli). Teeth 2/2, those of the outer files being much the stronger.

Coxae. Surface like that of capitulum. Internal spur on coxa I blunt but definite, length about 20 microns. External spur as a chitinous ridge. Internal spurs lacking on coxae II, III, and IV; external spurs poorly developed but all as definite projections. Median contour of coxa II markedly angular.

Spiracle. Subcircular, 170 microns by 150 microns. Goblets in one and two rows. Macula placed anteriorly. Genital opening between posterior margins of coxae III. Genital and anal grooves rounded.

*Contribution No. 2069, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

PLATE XV.



SPECIES OF *IXODES*

Male. (Plate XV, Fig. 10). Dimensions of allotype 2.5 mm. by 1.7 mm.

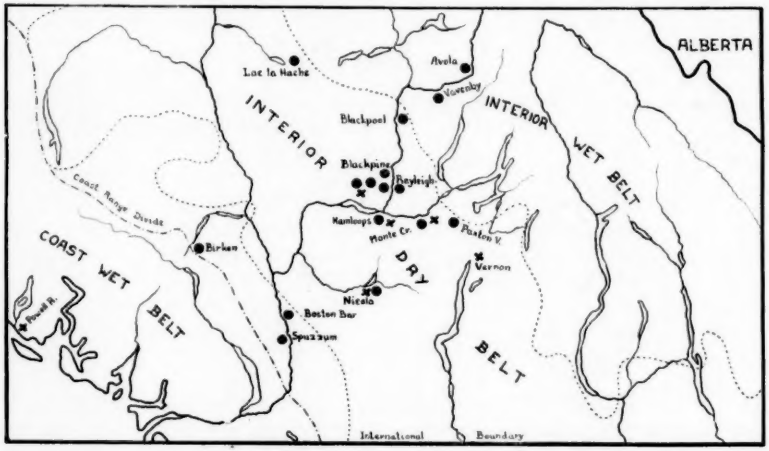
Dorsal aspect

Capitulum. Length 330 microns, width (at insertion of palpi) 320 microns. Cornua absent; sides of capitulum slightly shelved; surface rugose.

Palpi. Moderately rugose; articles 2 and 3, 260 microns by 150 microns.

Scutum. Convex, with regular punctations. Scapulae rounded; interscapular depression 90 microns. Lateral grooves prominent.

Legs. Tarsus I, 400 microns; metatarsus, 300 microns; tarsus I humped, tarsi II-IV less humped.



Distribution of *Ixodes hearlei* n. sp., indicated by dots, and of *Ixodes texanus* Banks, indicated by crosses.

Ventral Aspect

Capitulum. Hypostome 170 microns long, bilobed. Teeth in three equal outer files and one partial small inner file on each side. Files fused into about six serrated transverse rows.

Coxae. Coxa I with rounded internal spur. External spurs of coxae II-IV represented only by slight bulges.

Ventral Plates. Median plate about 950 microns long; anal plate 800 microns.

Spiracle. 170 microns by 150 microns, similar to that of female.

Nymph. (Plate XV, Fig. 11).

Dorsal aspect

Capitulum. Length 275 microns (tip of hypostome to dorsal ridge); width (at cornua) 275 microns; triangular, the shoulders of the capitulum forming an angle of about 55 degrees with the hypostome. Cornua absent. Postero-lateral margins of basis shelved at sides. Palpi robust but not very rugose; median profile evenly convex. Article 2, 108 microns; article 3, 96 microns; greatest width 89 microns.

Scutum. Length 500 microns; width 500 microns. Broadest in front of middle. Apex rounded. Cervical grooves shallow. Scapulae small and rounded;

interscapular depression 15 microns deep. Surface rugose and with occasional distinct punctations.

Ventral aspect

Capitulum. Auriculae present only as chitinized shelves. Hypostome length, 150 microns. Files 2/2, the outer much the stronger and about 8 teeth to a file.

Coxae. Prominent, rounded internal spur on coxa I. External spurs on coxae II, III, IV as definite bulges, not so marked on coxa I.

Spiracle. Ellipsoidal; 76 microns by 64 microns.

Larva. (Plate XV, Fig. 12).

Capitulum. Length 128 microns; width 140 microns. Shoulders sloping and at an angle of about 55 degrees to hypostome. Palpi 96 microns by 52 microns, widest at article 3. Cornua and auriculae absent. Hypostome 65 microns long; six large teeth in outer file, five smaller ones in inner. Scutum, length 257 microns; width 300 microns. Interscapular depression 32 microns.

Coxae. Internal spur of coxa I a slight bulge. Other spurs absent. Tarsus I, 153 microns; metatarsus 77 microns.

Holotype, female (No. 1857), *allotype,* male (No. 1864), two nymphs, and two larvae have been deposited in the Canadian National Collection at Ottawa, under type number 5205. Paratypic pairs, together with nymphs and larvae, have been forwarded to the United States National Museum at Washington, D. C., and to the Rocky Mountain Laboratory at Hamilton, Montana. All descriptions were made from specimens taken near Kamloops, the unengorged holotype having been collected from a squirrel's nest at Shumway Lake, B. C., on January 28, 1941. The allotype, four pairs of paratypes, and a number of engorged nymphs and larvae were sorted from squirrel's nests at Rayleigh on February 9, 1941. The described early stages (No. 243) were taken from a squirrel from the latter locality on August 2, 1929. Other specimens of this tick examined include material from more than thirty different collections made at Kamloops, Nicola, Vavenby, Birken, Spuzzum, and Lac la Hache, all in British Columbia.

The tick has been recorded only from the interior red squirrel, *Tamiasciurus hudsonicus streatori* (Allen) of which it is a common parasite. Its distribution appears to be closely related to that of its host, and its replacement by *Ixodes angustus* Neumann in the coast district commences where the interior squirrel gives place to Douglas' squirrel, *Tamiasciurus douglasi cascadensis* (Allen). *Ixodes hearlei* has been named after Eric Hearle, the late director of the Livestock Insect Laboratory at Kamloops, B. C.

In 1930, when tick studies at this laboratory were being incepted by Hearle, the above described species was noticed to differ in certain respects from *Ixodes marxi* Banks. However, because of the possession of certain features in common with the latter as well as its association with a closely related host, it was placed as this eastern tick in Hearle's paper, "The Ticks of British Columbia" (1). Besides being parasites of the red squirrel, *Tamiasciurus hudsonicus* (the respective hosts differing subspecifically only) both *hearlei* and *marxi* exhibit a general similarity in their elongated shapes when engorged, their spiracles, scuta, capituli, and coxae.

In favour of a distinction between these two ticks are the facts that geographical barriers separate them and their respective hosts, and that there are definite morphological differences, as noted below. *I. marxi* differs from *hearlei*, in that in the former the auriculae are more prominent; the scutum, while

similar, is definitely longer; the external coxal spurs are less marked, being practically absent, and the internal spur on coxa I is more rounded; and the internal profiles of the palpi are more angular. These differences and the above mentioned similarities are figured (Plate XV, Fig. 14, 13, 6B, 7B, 8B, and 9B) from two specimens of *I. marxi* (No. 28931) that were kindly loaned by Dr. F. C. Bishopp of the Bureau of Entomology, U. S. Department of Agriculture, Washington, D. C.

Another tick, with which there is a possibility of confusion, is *Ixodes texanus* Banks. This tick is usually found on weasels and mink, and according to the records of this laboratory, has never been taken as yet from squirrels, although there are several records of *texanus* and *hearlei* having been taken at localities where both hosts are present. Even though the two ticks overlap in their distribution in the interior of British Columbia, their differences remain constant and marked. Ten collections of *texanus* were examined and the following features found to distinguish the latter from *hearlei;* palpi, very broad and decidedly more rugose; hypostome, thicker and with stronger teeth; anterior shoulders of capitulum flatter than those of *hearlei* and with a large depression around base of chelicerae; internal spur of coxa I blunt and more rounded; internal contours of coxa II more rounded; scutum, as a rule, shorter and broader, and spiracle one-third larger, containing over four times as many goblets. Engorging specimens of *texanus* are definitely more ovoid in shape than either *marxi* or *hearlei*. Drawings of *I. texanus* (Plate XV, Fig. 6C, 7C, 8C, 9C and 15) are from specimens taken from Powell River, Kamloops laboratory stock No. 849.

Ixodes ochotonae n. sp.

Female. (Plate XVI, Fig. 1–7). Dimensions of unengorged holotype 2.21 mm. (to tip of scapula) by 1.38 mm.

Dorsal aspect

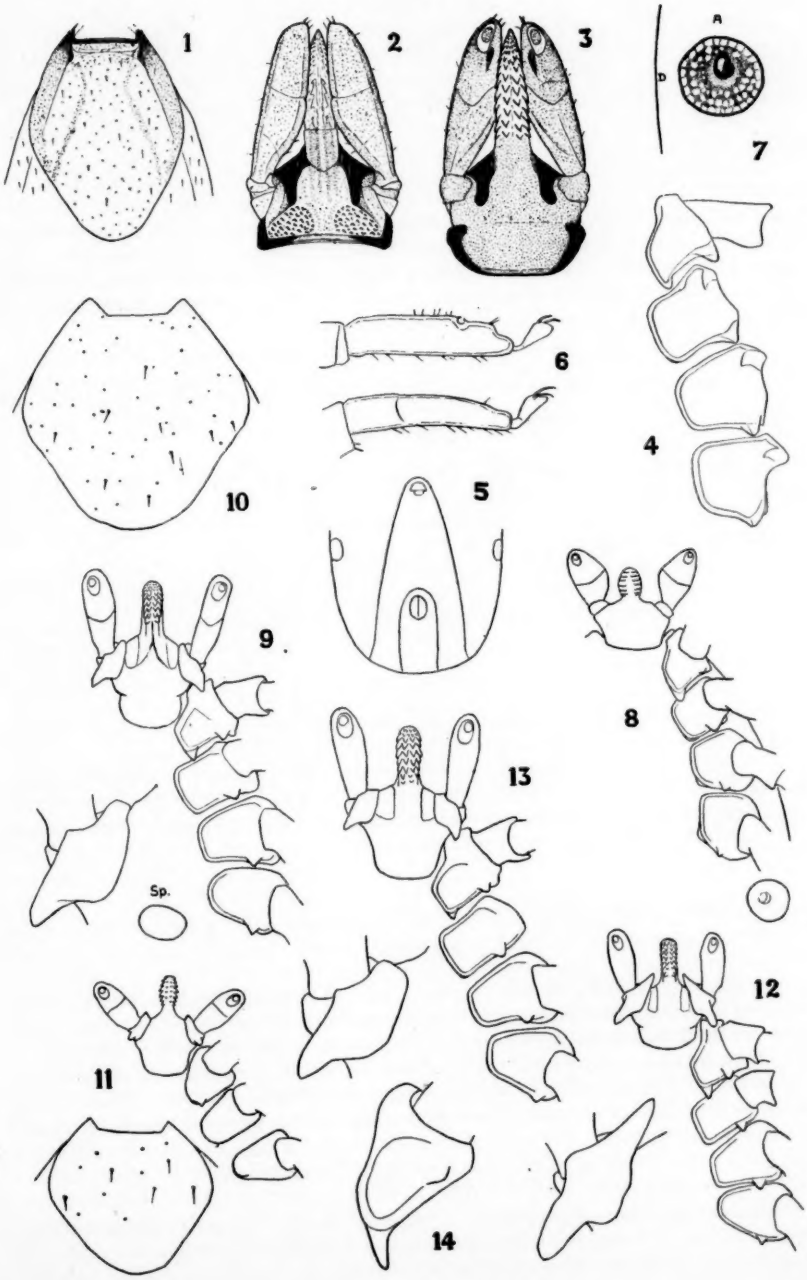
Capitulum. Length 660 microns (from tip of hypostome to dorsal ridge); width (at cornua) 410 microns. Surface of basis capituli smooth and impunctate; posterior border slightly concave; cornua practically absent and represented by a heavy and almost black thickening of the dorsal ridge. Porose areas triangular, 100 microns by 150 microns, bordered externally by the dorsal and marginal ridges and internally by slightly raised crescentic ridges; interval 70 microns. Porose areas and centre of the basis capituli a light brown colour. Front of basis V-shaped above the chelicerae and bordered by dark brown, heavily chitinized shoulders which extend back from the hypostome at an angle of about 55 degrees.

Palpi. Extending about 20 microns beyond tip of hypostome. Total length of articles 2 and 3, 550 microns; article 2, 300 microns. Anterior lateral profile of article 3 rounded; median profile of 3 straight and of 2 convex; combined lateral profile straight.

Scutum. 1.270 mm. by .95 mm.; broadest slightly in front of middle. Surface rugose, with many rather coarse, well-scattered, circular punctations. Interscapular depression of scutum about 150 microns deep; scapulae sharp and heavily chitinized, their inner margins extending backwards about 80 microns to the anterior margin of the body membrane. Cervical grooves very shallow and extending to posterior border of scutum; lateral and marginal grooves very prominent. Postscutal area covered sparsely with hairs.

Legs. Moderate in length and of a pale brown colour. Tarsus I very slightly humped; tarsi II, III, and IV tapering. Tarsus I, 530 microns; metatarsus, 350 microns.

PLATE XVI.



SPECIES OF *IXODES*

Ventral aspect

Capitulum. Impunctate and heavily chitinized. Auriculae present only as a chitinized ridge. Hypostome 370 microns long (tip to lateral junctions of basis capituli) and sharply pointed. Teeth 2/2 in holotype and four other specimens; the three remaining females examined had 2/3 and 3/3 files.

Palpi. Article 3 with a sharp ridge rising to an apex at median edge of article 4.

Coxae. Small pale hairs present. Coxa I bidentate. Internal spur blunt and about as broad as long; external spur slightly larger and broader than long. Coxa II with only the suggestion of an internal spur; coxae III and IV with none. External spurs on II-IV all progressively blunter than that on coxa I.

Spiracle. Nearly circular, 200 microns by 210 microns. Goblets in about two rows. Macula placed anteriorly. Genital opening between posterior margins of coxae III. Genital and anal grooves rounded.

Male. (Plate XVI, Fig. 8). Dimensions of allotype 2.02 mm. by 1.30 mm.

Dorsal aspect

Capitulum. Length 280 microns, width (at insertion of palps) 310 microns. Suggestion of cornua.

Palpi. Short, with very convex inner profile. Articles 2 and 3, 250 microns by 130 microns.

Scutum. Punctation evenly distributed. Scapulae rounded; interscapular depression, 35 microns. Lateral grooves fairly prominent.

Legs. Tarsus I slightly humped and 400 microns long; metatarsus, 300 microns.

Ventral aspect

Capitulum. Hypostome 120 microns long, rounded at tip, and bearing 3/3 files in about 5 transverse rows.

Coxae. Internal spur on coxa I strong, external spur practically absent. Internal spurs on coxae II-IV as faint rounded ridges, external spurs prominent.

Ventral plates. Median plate 800 microns long; anal plate 600 microns.

Spiracle. 180 microns by 170 microns.

Nymph. (Plate XVI, Fig. 9 and 10).

Dorsal aspect

Capitulum. Length 185 microns (tip of hypostome to dorsal ridge); width (at cornua) 230 microns. Cornua present, projecting postero-laterally. Palpal article 2, 96 microns; article 3, 128 microns; greatest width 76 microns.

Scutum. Length 540 microns; width 575 microns; broadest slightly behind the middle. Apex broadly rounded, Scapulae obtusely pointed; interscapular depression 30 microns deep. Surface very slightly rugose, with regularly spaced punctations.

Ventral aspect

Capitulum. Auriculae absent. Palpal article I projecting postero-laterally as a stout spine. Anterior projection unpronounced. Hypostome length 109 microns. Files 2/2, the outer teeth slightly the stronger and about seven to a file.

Coxae. Spurs as in female.

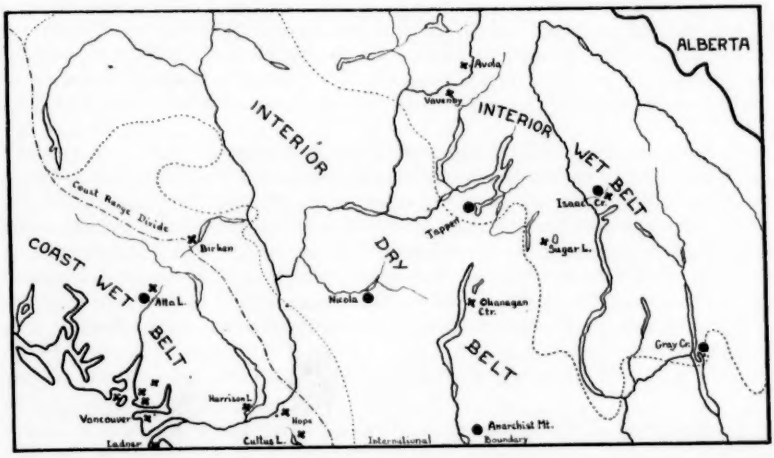
Spiracle. Ellipsoidal; 122 microns by 77 microns.

Larva. (Plate XVI, Fig. 11).

Capitulum. Length 135 microns; width 147 microns. Palpi, 115 microns by 45 microns, rounded at ends and with very slightly convex sides. Palpal article 1 with rounded posterior projection and an anterior sharp conical spur, equiangular in shape. Cornua projecting laterally; auriculae absent. Hypostome 77 microns long; outer file with 6 teeth, inner file with 5 smaller teeth. Scutum, length 290 microns; width, 370 microns.

Coxae. Internal spur of coxa I sharp and slightly obtuse. Other spurs only as insignificant bulges. Tarsus I, 210 microns; metatarsus, 96 microns.

Holotype, female (No. 1636), and *allotype,* male No. 708, two nymphs, and two larvae have been deposited in the Canadian National collection at Ottawa under type number 5206. One paratype



Distribution of *Ixodes ochotonae* n. sp. indicated by dots, and of *Ixodes angustus* Neumann, indicated by crosses.

female (No. 1636), two nymphs, and two larvae have also been forwarded to the United States National Museum, Washington, D. C. Description of holotype and early stages (No. 1728) were made from material taken from *Ochotona princeps* ssp., probably *brooksi* (Howell), at Tappen, near Salmon Arm, B. C.; that of the allotype, from a male from *Ochotona princeps brunnescens* (Howell) taken at Anarchist Mountain, near Osoyoos, B. C.

Specimens examined are as follows: No. 1636, holotype and one female paratype (collected as nymphs), and sixty nymphs and larvae, from *Ochotona princeps brooksi,* Tappen, B. C., March 31, 1940. No. 1552, one nymph from *Ochotona princeps brooksi,* Tappen, B. C. May 23, 1938. No. 1728, four larvae from *Ochotona princeps brooksi,* Tappen, B. C., May 24, 1940. No. 1908, two larvae from *Peromyscus* sp., Tappen, B. C., May 24, 1940. No. 1210, two females, one nymph, one larva, from *Ochotona princeps* ssp., Gray Creek, B. C., June 5, 1936. No. 1261, three nymphs and one larva from *Ochotona princeps* ssp., Gray Creek, B. C., June 4, 1936. No. 708, four females and one male (allotype) from *Ochotona princeps brunnescens,* Anarchist Mt., B. C., July 10, 1932. No. 1583, one nymph from *Neotoma cinerea* ssp., Wigwam, B. C., June 11, 1939.

Other specimens examined, believed to be *I. ochotonae* but of uncertain identity due to mutilation or lack of other stages: No. 795, two larvae from *Ochotona princeps* ssp., Nicola, B. C., August 3, 1934. No. 352, one nymph and one larva from *Ochotona princeps* ssp., Nicola, B. C., August 26, 1932. No. 716, two females from *Ochotona princeps* ssp., Mons, B. C., August 2, 1932.

Ixodes ochotonae is very closely related to *I. angustus* Neumann (2), but because of a marked difference in the shape of palpal article 1 in the nymph of the former which occurs regularly in the specimens taken from pika, and since this structure has not been found to vary among some hundred nymphs of *angustus*, the tick has been described as a distinct species. The females of *ochotonae* are distinguishable from those of *angustus* in that the scutum and capitulum of the former are relatively more rugose and more heavily chitinized, and the lateral grooves and punctations are deeper and more pronounced; chitinous areas are a dark red brown instead of a pale brown; the basis capituli is broader and less deep; and files of hypostome may be 2/2 or 3/3, whereas out of 15 *angustus* examined they were all 3/3 in number. In the nymphal stage, article 1 lacks the anteriorly directed spine that is present in *angustus*. On account of this, the nymph of *ochotonae* is remarkably similar to that of *I. marmotae* Cooley and Kohls (4), even though there is a vast difference between the adults (seen drawings of nymph and female *I. marmotae*, Plate XVI, Fig. 13 and 14.

The possibility of *I. ochotonae* being synonymous with *I. angustus* var. *woodi* Bishopp (3) has been considered. Specimens of the latter (No. 1563 and 1746) have been borrowed and examined through the kindness of Dr. F. C. Bishopp. Besides the type locality of this tick being in Texas, various features, such as smaller spiracles, a longer internal spur on coxa I, and a longer capitulum render it distinct from *ochotonae*. *I. angustus* var. *woodi*, however, does resemble *ochotonae* in that the files of the hypostome (on the female specimen examined) are 2/2, and the palpal article 1 of the nymph lacks an anterior spine.

EXPLANATION OF PLATE XV.

Fig. 1, Scutum of *I. hearlei*. 2, Capitulum of *I. hearlei*, dorsal view. 3, Capitulum of *I. hearlei*, ventral view. 4, Coxae of *I. hearlei*. 5, Anal and genital grooves of *I. hearlei*. 6, A, palpus of *I. hearlei*; B, of *I. marxi*; C, of *I. texanus*. 7, A, tarsus of *I. hearlei*; B, of *I. marxi*; C, of *I. texanus*. 8, A, outline of engorged *I. hearlei*; B, of *I. marxi*; C, of *I. texanus*. 9, A, spiracle of *I. hearlei*; B, of *I. marxi*; C, of *I. texanus*. 10, Venter of *I. hearlei*, male. 11, Venter and scutum of *I. hearlei*, nymph. 12, Venter and scutum of *I. hearlei*, larva. 13, Scutum of *I. marxi*. 14, Auricula and coxa of *I. marxi*. 15, Ventral view of capitulum and coxa I of *I. texanus*.

EXPLANATION OF PLATE XVI.

Fig. 1, Scutum of *I. ochotonae*. 2, Dorsal view of capitulum of *I. ochotonae*. 3, Ventral view of capitulum of *I. ochotonae*. 4, Coxae of *I. ochotonae*. 5, Anal and genital grooves of *I. ochotonae*. 6, Tarsus I and Tarsus IV of *I. ochotonae*. 7, Spiracle of *I. ochotonae*. 8, Ventral view of *I. ochotonae*, male. 9, Ventral view of *I. ochotonae*, nymph. 10, Scutum of *I. ochotonae*, nymph. 11, Ventral view of scutum of *I. ochotonae*, larva. 12, Ventral view of *I. angustus*, nymph. 13, Ventral view of *I. marmotae* nymph. 14, Coxa I of *I. marmotae*, female.

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THE NYMPH OF *AESCHNA VERTICALIS* HAGEN

BY E. M. WALKER,

Department of Zoology, University of Toronto

Aeschna verticalis Hagen has been for some years the only species of the genus from eastern North America, whose nymph was unknown, except the rare *A. mutata* Hagen. At last, unexpectedly, the writer found *A. verticalis* in transformation at Clementsport, Annapolis Co., Nova Scotia.

On July 5, 1940, while collecting in this vicinity, I was guided by the resonant croaking of Green Frogs (*Rana clamitans* Latr.) to a small, pond-like expansion of a spring in a boggy, upland pasture at the edge of a wood. The spring had been dammed by logs so long ago that the pond had acquired quite a natural appearance, although peculiar in that the emergent vegetation was nearly a pure stand of a single species of coarse sedge (*Carex* sp.), covering almost the entire area of the pond, which was approximately an acre in extent.

My first visit to this pond was made in the forenoon and yielded little of interest, but I returned there at about 5.30 p.m. on the same day and found two newly-emerged Aeschnas, ♂ and ♀, with their exuviae. They were white and opaque with folded wings, but when their colours had developed they proved to be *A. verticalis*.

On the following day, at about 11 a.m., two more Aeschnas, both females, were found with their exuviae and on July 7, many exuviae together with a male and several female adults were found during the forenoon. As their wings were already spread and clear they had doubtless emerged early in the morning. On July 8 fourteen exuviae were found, several of them accompanied by the adults. No further visits were made to the pond until July 20, when a few exuviae were found but no adults. The period of emergence was apparently about over. All of these exuviae were clinging to the stems or leaves of the sedges, usually eight to twelve inches above the water, and the adults, when present, were often more or less hidden, although usually found with little difficulty. No other species of *Aeschna* was represented among them.

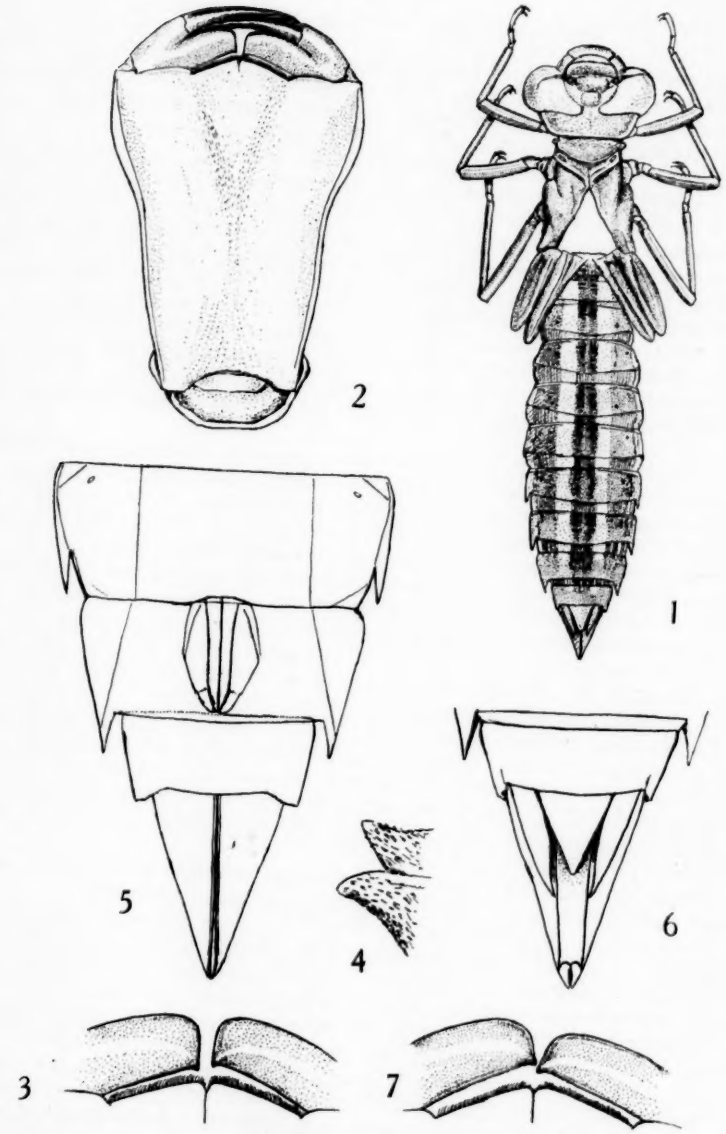
The exuviae of *Aeschna verticalis* (Fig. 1) are very similar to those of *A. canadensis* Walker (Walker '12), as would be expected, but are darker than usual in this species and not quite so conspicuously striped. There are, however, individual exuviae of *A. canadensis* which are practically indistinguishable in colour-pattern from those of *A. verticalis*. The only constant difference which was found is in the labial palpi (*v. inf.*).

General colour dusky brown with a darker mid-dorsal abdominal stripe and paler submedian bands (Fig. 1); thorax and legs concolorous.

Head brown, deepened on the dorsal muscle scars, with paler lateral marginal areas. Thorax, wing-sheaths and legs uniform brown. Ground colour of abdomen as in thorax; an unbroken dark median band extending the entire length of the abdomen from seg. 1 to 10, subequal with parallel sides to base of 7, somewhat widened anteriorly on 7-9, often obscure on 10; submedian pale bands usually a little narrower than the dark band but sometimes a little wider anteriorly; bounding the pale bands laterally are wider areas of the ground colour bearing the darker puncta, which are usually a little more heavily marked than in *canadensis;* and laterad of these are somewhat paler marginal zones bounded mesally by the dorso-lateral muscle scars.

Head widest across the vertex; eyes moderately prominent as in *canadensis*, appearing in dorsal view most convex a little behind the middle. Lateral margins behind the eyes barely convex or straight, passing into well-rounded hind angles; hind margin in direct dorsal view barely excavate. Mentum of labium (Fig. 2) widest at distal end, the width here being three-fourths of the length; width

PLATE XVII.



NYMPHS OF *AESCHNA*

Fig. 1–6. *Aeschna verticalis* Hagen; 1, dorsal view of exuvia; 2, labium; 3, terminal lobes of labial palpi; 4, left propleural processes; 5, terminal segments of female abdomen, ventral view; 6, anal pyramid of male, dorsal view.

Fig. 7. *Aeschna canadensis* Walk., terminal lobes of labial palpi.

at base one-third of the length; lateral margins in proximal three-fifths slightly divergent and feebly convex, in distal two-fifths strongly convex; median lobe forming an angle of about 135°, its margins slightly curved. Palpi with terminal lobes. (Fig. 3) scarcely narrowing distally, truncate with the anterior angles somewhat abruptly rounded, posterior angles somewhat obtusangulate, except at the immediate apex, which bears a small tooth.

Propleural processes (Fig. 4) of nearly equal length, the posterior a little stouter, their apices slightly divergently curved.

Lateral spines on abdominal segments 6 to 9, not at all flaring; those on 6 reaching one-fourth to one-third of the distance to the base of 7, those on 7 two-thirds to three-fourths the distance to the base of 8, those on 8 reaching the base of 9, and those on 9 reaching nearly half-way to the hind margin of 10. Anal pyramid as long as segments 9 + 10 (Fig. 5), its width at base two-thirds of its length; inferior appendages (Fig 6) only slightly surpassing the median appendage, their apices incurved only at the extreme tips; cerci (dorso-lateral appendages) reaching to about three-fifths the length of the pyramid, slender, straight, tipped with a fine black spine; sheath of adult inferior appendage of male a little less than half as long as the pyramid, triangular, the base about equal to the length; sides feebly concave. Ovipositor just reaching hind margin of segment 9, not including the intersegmental membrane.

Total length (mm.) 36.5–40.5; abdomen 26.0–27.5; mentum of labium 6.5; hind wing 8.0–9.0; hind femur 6.6–7.0; anal pyramid 4.0; ovipositor 2.2–2.3; width of head 8.0–8.3; width of abdomen 8.0.

The nymph of *A. verticalis* is nearest that of *A. canadensis*, from which it shows no constant difference except in the labial palpi. These are more nearly truncate, their antero-distal angles being more abruptly rounded and their distal margins forming with their posterior margins an angle somewhat greater than a right angle (Fig. 3), while in *A. canadensis* (Fig. 7) the angle is somewhat less than a right angle. In *A. clepsydra* Say these differences are still more pronounced, while in other members of the *grandis* (or *clepsydra*) group the femora are more or less distinctly banded and the abdomen is less evenly striped, the bands being broken into spots. The nymph of *verticalis* is also extremely like those of *A. juncea* L. and *A. subarctica* Walk. but the mentum of the labium is slightly more elongate than in these species, the distal width being about 75 per cent of the length, whereas in *juncea* and *subarctica* (Walker '34) the distal width is 80 to 85 per cent of the length. The lateral margins are distally slightly less strongly arcuate than in *juncea* and a little more so than in *subarctica*. The lateral spines on segment 5 are more marked than in the latter species. Where localities are known it is unlikely that *verticalis* would be mistaken for either *juncea* or *subarctica*, since its range, at least in Ontario, lies wholly south of the ranges of these two boreal species.

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THE GENUS *GRAMMOTAULIUS* IN NORTH AMERICA, WITH THE DESCRIPTION OF A NEW SPECIES (TRICHOPTERA, LIMNEPHILIDAE).

BY DONALD G. DENNING,

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Four species of the Genus *Grammotaulius*, one of which is now considered a synonym, have been recognized in North America. These have been recorded only from Greenland, Canada, and northwestern United States. In August, 1940, Dr. C. E. Mickel and Mr. H. E. Milliron collected a series including both sexes of a new species in Colorado. *Grammotaulius interrogationis* (Zett.), the species which has, apparently, the widest distribution, is here recorded from Minnesota. Descriptions of the previously unknown females of *interrogationis* (Zett.) and *bettenii* H.-G. are presented in this paper, together with redescriptions of the males.

I wish to express my gratitude to Dr. Cornelius Betten for his generous assistance and loan of material.

Grammotaulius interrogationis (Zett.)

Zetterstedt, 1840, p. 1063; Hagen, 1861, p. 254; Hagen, 1873, p. 450; Hagen, 1873, p. 451 (*praecox*); Ulmer, 1905, p. 18; Ulmer, 1907, p. 39 (*praecox*); Mosely, 1929, p. 508, Fig. 5, 6; Betten, 1934, p. 316; Betten, 1934, p. 316 (*praecox*); Milne, 1935, p. 27, 50 (designated as Genotype); Milne, 1935, p. 50 (*praecox* placed as synonym); Ross, 1938, p. 32 (*praecox*).

Male. Genitalia as in Fig. 2 and 2A. Ninth segment constricted to a narrow ridge dorsally, anterior margin straight. Plates of tenth tergite with only a small portion of rounded ventral portion discernable when viewed laterally; the dorsal lobe with ventro-caudal angle produced into an acute point. Cerci quite deeply excavated along distal margin, the ventro-distal corner produced into a slightly upcurved point, the distal margin blackened and coarsely dentate; the inner distal submarginal area irregularly dentate. Claspers small, triangular, projected directly caudad. Lateral arms of aedeagus, Fig. 2A, entirely sclerotized, almost as long as mesal portion; the dilated apices with a sharp digit-like projection at base of dorsal margin, the fringe of dense stout setae extending slightly round the apex. Inner margin of digit-like process with a row of long stout spines projecting caudad.

Genitalia drawn from male collected at Cook County, Minnesota, July 30, 1938, Roger Anderson.

Female. Genitalia as in Fig. 1 and 1A. Side piece of ninth tergite triangular, ventral margin curved ventrad. Cerci finger-like, tapering ventrad about two-thirds length of dorsal margin of tubular piece. Tubular piece deeply excised, the dorsal margin projecting beyond ventral margin. Median lobe of vulvar scale, Fig. 1A, obliquely rounded at apex, longer than side-lobes, whose apices are truncate.

Genitalia drawn from female collected at Churchill River, twenty miles south of Churchill, Manitoba, August 5-6, 1937, D. G. Denning.

Material examined: 3 ♂♂, 1 ♀, from Churchill River, twenty miles south of Churchill, Manitoba, August 5-6, 1937, (D. G. Denning) and Cook County, Minnesota, July 30, 1938, (Roger Anderson).

Grammotaulius interrogationis was described by Zetterstedt in 1840 from material collected from the west coast of Greenland. The specimen collected in Cook County, Minnesota, constitutes the first recorded presence of this species within the United States. Previous to this the species has been known only from Greenland, Labrador, and northern Canada. *Grammotaulius praecox* Hagen was described from a male and female (female without abdomen) collected at Fort Resolution on Great Slave Lake, Canada. Mosely, 1929, has de-

scribed the male and illustrated the lateral and dorsal views of the genitalia.

Grammotaulius lorettae n. sp.

Male. Wing expanse 42 mm. Head and pronotum yellowish, mesonotum with center portion yellowish, sides black. Head and thorax bearing silvery setae. Anterior wing pale stramineous, a variable amount of brownish irrorations over all of wing; wing sparingly covered with silvery and black setae. The apical portion of wing obliquely truncate. Posterior wings with the characteristic blackened line along margin of cell R_5.

Genitalia as in Fig. 4 and 4A. Ninth segment suddenly constricted to a narrow ridge dorsally, anterior margin straight. Plates of tenth tergite thin, heavily sclerotized, when viewed laterally only a small portion of rounded ventral angle discernable; dorsal portion attenuated, when viewed dorsally their apices divergent. Cerci subquadrate, the apice-ventral corner produced into a dorsad directed point; distal margin blackened and coarsely dentate; the inner distal submarginal area coarsely dentated. Claspers narrow, apex acute, directed caudad beyond cerci. Lateral arms of aedeagus entirely sclerotized, Fig. 4A, gradually broadened apically then tapering to an acute point, slightly longer than mesal portion; distal end bearing a fringe of dense stout setae, inner surface bearing several long stout spines.

Female. Wing expanse, general color and structure similar to the males.

Genitalia as in Fig. 3 and 3A. Side piece of ninth segment subquadrate, ventral margin only slightly curved dorsad. Cerci short, stocky, extending caudad almost as far as dorso-caudal corner of tubular piece. Distal margin of tubular piece quite deeply excised, ventral margin extending considerably beyond dorsal margin. Median lobe of vulvar scale triangular, Fig. 3A, about same length as the truncate side-lobes.

Holotype. Male, Camerson Pass, Colorado, August 20, 1940, at light, elevation 9,850 feet, C. E. Mickel and H. E. Milliron.

Allotype. Female, same data as for holotype.

Paratypes. Same data as for holotype, 3 ♂♂, 1 ♀.

All types deposited in the University of Minnesota Collection.

Grammotaulius bettenii Hill-Griffin

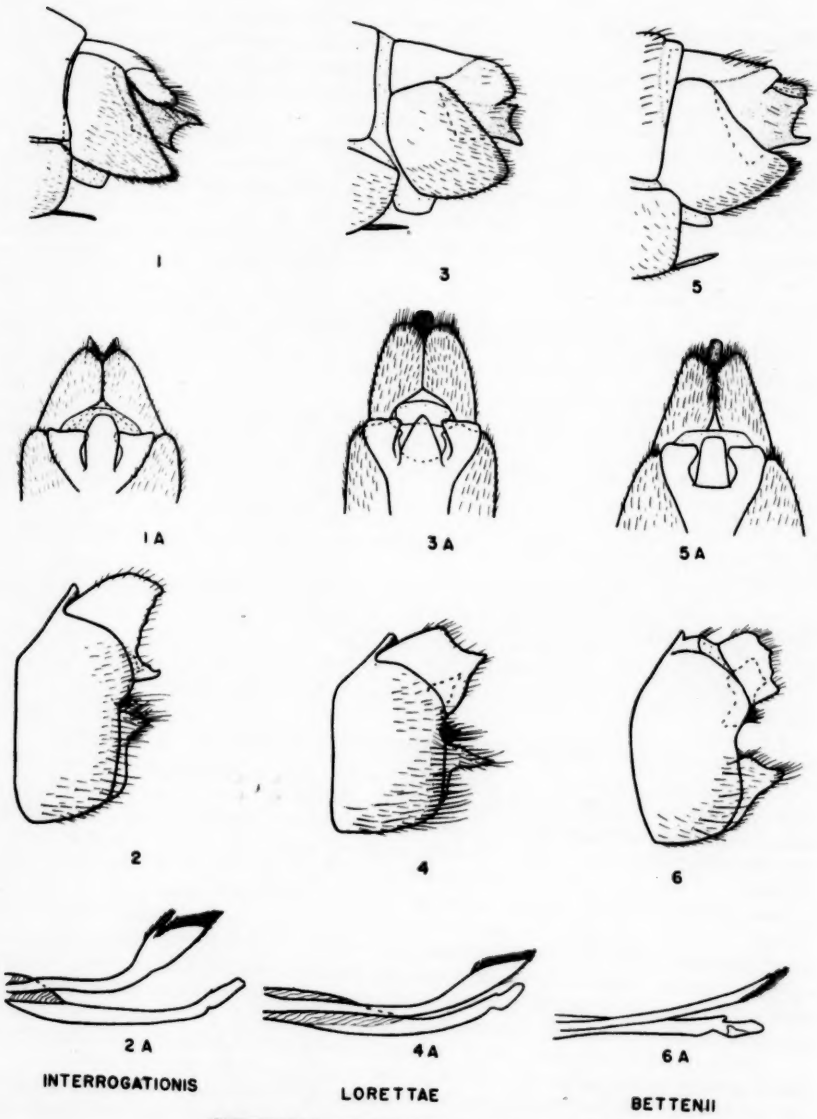
Hill-Griffin, 1912, p. 18, Pl. 3, Fig. 1-14; Betten, 1934, p. 316; Milne, 1935, p. 27, 50.

Male. Genitalia as in Fig. 6 and 6A. Ninth segment reduced to a narrow collar dorsally; anterior margin gently curved. Plates of tenth tergite thin, heavily sclerotized, only a small portion of ventral angle visible when viewed laterally; the dorsal portion produced caudally into a truncate point. Cerci approximately half as wide as long; mesal portion of distal margin slightly convex, distal margin blackened and coarsely dentate; the inner distal submarginal area dentate. Clasper short and stocky, triangular, apex directed slightly dorsad. Lateral arms of aedeagus, Fig. 6A, entirely sclerotized, narrow, gradually tapering to a sharp point, longer than mesal portion; distal end bearing a fringe of dense stout setae, longest at apex.

Genitalia drawn from male collected at Sherwood, Oregon, September 25, 1906, (Betten Collection).

Female. Genitalia as in Fig. 5 and 5A. Side piece of ninth segment broadly triangular, the ventral margin curved dorsad. Cerci narrow, finger-like, extending caudad almost as far as dorso-caudal corner of tubular piece. Tubular piece with dorso-caudal corner obtuse; ventro-caudal corner narrowed, acute distally, projecting caudad slightly beyond dorso-caudal corner. Median lobe of vulvar scale, Fig. 5A, truncate, slightly longer than the truncate side-lobes.

PLATE XVIII.



GENITALIA OF *GRAMMOTAULIUS*

Genitalia drawn from female collected at Mary's Peak, Oregon, October 12 (Betten Collection).

Material examined: 2 ♂♂, 1 ♀, from Sherwood, Oregon, September 25, 1906, and Mary's Peak, Oregon, October 12.

Adult and immature specimens have been described by Hill-Griffin from specimens reared in Oregon. Milne has recorded this species from southern British Columbia.

Grammotaulius sibiricus McL.

McLachlan, Rev. and Syn., p. 40, Pl. V, Fig. 1-4 (♂), Suppl. p. IV, XVI, Pl. LIII, Fig. 1-2 (♀); Martynov, 1914, p. 205; Mosely, 1929, p. 502; Betten, 1934, p. 316.

This species was described by McLachlan from a male and female collected in Eastern Siberia (Maack). Major R. W. G. Hingston, on the Oxford University Expedition to Kugssuk, Godthaab Fjord, Greenland, in 1928, collected a female *Grammotaulius*. This specimen was determined as *sibiricus* McL. by Mosely who wrote, "On the 16th of July a female *Grammotaulius sibiricus* was taken on the 30 foot line (altitude)—a very pale example with but lightly mottled wings."* There is, apparently, some doubt regarding the exact determination of this species, for Mosely later writes, "There is the further possibility that Major Hingston's female *Grammotaulius*, although agreeing in every particular with McLachlan's description and figures of *sibiricus*, may be actually the female that should be referred to Dr. Petersen's species (*interrogationis* Zett.), for the differences in the genitalia of the female sex in *Grammotaulius* are very obscure."†

The male and female genitalia of *Grammotaulius sibiricus* McL. have been illustrated by McLachlan.

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* M. E. Mosely, Trichoptera and Ephemeroptera from Greenland, Ann. and Mag. Hist., (ser. 10) IV (1929), p. 504.

† ibid., p. 508.

BOOK NOTICES

ATLAS OF THE SCALE INSECTS OF NORTH AMERICA, SERIES III.

By Gordon Floyd Ferris. Published March 27, 1941, by Stanford University Press, Stanford University, California. Price unbound $6.75, bound $7.75.

It is a pleasure to note the appearance of a third series of the now well known *Atlas of the Scale Insects,* which was commenced only in 1937 and which is now rapidly assuming encyclopedic proportions. All the excellent features of the preceding series are maintained in the present volume. The format is the same, consisting of a concise text for each genus and species, accompanied by a plate of line drawings depicting the gross morphology and structural details of the species in question.

The present series is comprised of units 269 to 384 and deals with the family Diaspididae, tribes Diaspidini and Aspidiotini. The great majority of the species discussed are from the regions of Panama, Mexico, and the southermost United States. Twenty-three genera and 45 species of Diaspidini, and 13 genera and 50 species of Aspidiotini are characterized. Of these numbers 14 genera and 64 species are described as new. Much of this new material is based on the author's own collecting in the above mentioned regions.

G. S. Walley.

BUTTERFLIES

By R. W. Macy and H. H. Shepard. University of Minnesota Press, Minneapolis, Minnesota. 240 pages; 74 illustrations. 1941. Price $3.50.

All persons interested in butterflies will be grateful to Drs. H. H. Shepard and R. W. Macy, for a most attractive book dealing with the butterflies which occur in that region of the United States and adjacent Canada which lies east of the Dakotas and Nebraska, and north of Missouri, Kentucky, and Virginia.

The introductory paragraphs deal with curious facts about butterflies, their connection in folklore and primitive life, coloration and protective mimicry butterfly odors and sense organs, hibernation and migration, economic importance, habits and ranges, directions for making a collection of butterflies, and many other topics including the life zones of North America, the classification of insects, and the general morphology of butterflies.

The main purpose of the book is to enable one to identify almost all of the butterflies occurring in the area dealt with. This is accomplished by the inclusion of simple keys to families, genera, and species of butterflies occurring in this region, together with a detailed description of each species, references to original descriptions, and brief synonymies. Notes are also given on geographical distribution, larval food plants, and interesting habits. Four beautiful plates depict twenty-nine species in natural color, and it is unfortunate that more plates could not have been included. However, good photographs of forty-five other species are shown in halftone, and these assist a great deal in identification. In all, the book deals with seventy-one genera, including one hundred and sixty-two species and twenty-seven geographical races and so-called forms.

In a critical sense it might be noted that the following omissions have occurred, which come well within the area figured as limiting the scope of the book: *Erora laeta* Edw., described from southern Ontario, is reported as occurring in Quebec, Vermont and West Virginia; *Oeneis chryxus strigulosa* McD. occurs in southern Ontario and Michigan. The descriptions of *Incisalia niphon clarki* Frmn. and *Strymon acadica watrini* Dufr. may have been published too late to be included.

T. N. Freeman.

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CORRECTION

page 199, line 31, for "others had B chromosomes" read "others had 6 chromosomes".